

# CHAITANYA SCIENCE AND ARTS COLLEGE

(AUTONOMOUS)

PAMGARH, JANJGIR-CHAMPA (C.G.)



ACCREDITED "A" GRADE BY NAAC

DEPARTMENT

OF

MATHEMATICS

COURSE CURRICULUM & MARKING SCHEME

POSTGRADUATE PROGRAMME

M.SC. MATHEMATICS

PROGRAM CODE: CCMS03

FIRST & SECOND SEMESTER

Approved By	Board of Studies	Academic Council
Date	30/08/2025	04 SEP 2025

**ACADEMIC YEAR 2025-26**

SYLLABUS FRAMED ACCORDING TO THE NEP-2020

UNDER THE SCHEME OF CBCS (CHOICE BASED CREDIT SYSTEM)

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## Scheme of M.Sc. Mathematics (Semester System)

Program Code: CCMS03

Semester	Course Code	Subject Name	Credit (L-T-P)	Max Marks	Internal	Total Marks	Min Marks	Total Credit
<b>First</b>	MMAT101	Advanced Abstract Algebra - I	3/1/-	70	30	100	40	4
	MMAT102	Real Analysis - I	3/1/-	70	30	100	40	4
	MMAT103	Topology - I	3/1/-	70	30	100	40	4
	MMAT104	Complex Analysis - I	3/1/-	70	30	100	40	34
	MMAT105	Advanced Discrete Mathematics - I	3/1/-	70	30	100	40	4
<b>Total (First)</b>			<b>15/5/-</b>			<b>500</b>		<b>20</b>
<b>Second</b>	MMAT201	Advanced Abstract Algebra - II	3/1/-	70	30	100	40	4
	MMAT202	Real Analysis - II	3/1/-	70	30	100	40	4
	MMAT203	Topology - II	3/1/-	70	30	100	40	4
	MMAT204	Complex Analysis - II	3/1/-	70	30	100	40	34
	MMAT205	Advanced Discrete Mathematics - II	3/1/-	70	30	100	40	4
<b>Total (Second)</b>			<b>15/5/-</b>			<b>500</b>		<b>20</b>

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**NAME OF PROGRAM: M.Sc. Mathematics (CCMS03)**

**Program Outcomes: -**

Program outcomes describe what students are expected to know or be able to do by the time of Post-Graduation. On completion of M.Sc. Mathematics program students will be able to-

1. Understand fundamental axioms in Mathematics and capability of developing ideas based on them.
2. Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate technique to solve them.
3. Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
4. Equip with skills to analyze problems, formulate a hypothesis, evaluate and validate results and draw reasonable conclusion thereof.
5. Gain advanced knowledge on topics in pure mathematics, empower to pursue higher degrees at reputed academic institutions.
6. Pursue research or careers in industry in mathematical sciences and allied fields.
7. Gain knowledge of a wide range of mathematical technique and application of mathematical methods/tools in other scientific and technological domains.
8. Gain advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.
9. Gain strong foundation on Algebraic Topology and representation theory and good understanding of number theory which can be used in modern online cryptographic technologies.
10. Provide a systematic understanding of the concepts and theories of mathematics and their applications in the real world-to an advanced level, and enhance career prospects in a huge array of fields.
11. Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standard of ethical issues in mathematical sciences.
12. Select, interpret, and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and internet.
13. Recognize the needs to engage in lifelong learning through continuing education and research.

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## **IMPORTANT NOTES:**

1. **From the academic session 2025–2026**, all question papers in the first and second semesters of the M.Sc. Mathematics program will be compulsory.
2. **Evaluation Structure (Semesters I & II):**
  - Total Theory Papers: 05 (350 Marks), Internal Assessment: 150 Marks.
  - **Total Marks: 500**
  - **Minimum Passing Marks: 40** in each course including External and Internal Exam.
3. **Examination Scheme:**
  - **Each paper will be evaluated as follows:**
  - End-Semester Examination: 70 Marks
    - **Section A** – 10 objective-type questions, one from each unit, without internal choice ( $1 \times 10 = 10$  marks).
    - **Section B** – 4 short-answer questions, 5 marks each, one from each unit with internal choice ( $5 \times 4 = 20$  marks). At least one question from every unit must be included.
    - **Section C** – 4 long-answer questions, 10 marks each, one from each unit with internal choice ( $10 \times 4 = 40$  marks). At least one question from every unit must be included.
  - Continuous Internal Evaluation (CIE)/Internal Assessment includes: 30 Marks
    - Two tests (20 marks each), 10 marks for assignment, attendance, group discussions, and presentations, and as decided by the institution.

# SYLLABUS AND MARKING SCHEME FOR THE FIRST & SECOND SEMESTER

## M.SC. MATHEMATICS

SESSION-2025-26

### SEMESTER - I

Sr. No.	Course Code	Subject Name	Credit (L-T-P)	Max Marks	Internal	Total Marks	Min Marks	Total Credit
01	MMAT101	Advanced Abstract Algebra - I	3-1-0	70	30	100	40	4
02	MMAT102	Real Analysis - I	3-1-0	70	30	100	40	4
03	MMAT103	Topology - I	3-1-0	70	30	100	40	4
03	MMAT104	Complex Analysis - I	3-1-0	70	30	100	40	4
05	MMAT105	Advanced Discrete Mathematics - I	3-1-0	70	30	100	40	4
<b>Total (First)</b>						<b>500</b>		<b>20</b>

### SEMESTER - II

Sr. No.	Course Code	Subject Name	Credit (L-T-P)	Max Marks	Internal	Total Marks	Min Marks	Total Credit
01	MMAT201	Advanced Abstract Algebra - II	3-1-0	70	30	100	40	4
02	MMAT202	Real Analysis - II	3-1-0	70	30	100	40	4
03	MMAT203	Topology - II	3-1-0	70	30	100	40	4
04	MMAT204	Complex Analysis - II	3-1-0	70	30	100	40	4
05	MMAT205	Advanced Discrete Mathematics - II	3-1-0	70	30	100	40	4
<b>Total (Second)</b>						<b>500</b>		<b>20</b>

### SEMESTER - III

Sr. No.	Course Code	Subject Name	Credit (L-T-P)	Max Marks	Internal	Total Marks	Min Marks	Total Credit
01	MMAT301	Integration Theory and Functional Analysis - I	3-1-0	70	30	100	40	4
02	MMAT302	Partial Differential Equations – mechanics and Gravitation - I	3-1-0	70	30	100	40	4
03	MMAT303	Fuzzy Sets and their Application - I	3-1-0	70	30	100	40	4
04	MMAT304	Operations Research – I	3-1-0	70	30	100	40	4
05	MMAT305	Fluid Dynamics – I	3-1-0	70	30	100	40	4
<b>Total (Second)</b>						<b>500</b>		<b>20</b>

### SEMESTER - IV

Sr. No.	Course Code	Subject Name	Credit (L-T-P)	Max Marks	Internal	Total Marks	Min Marks	Total Credit
01	MMAT301	Integration Theory and Functional Analysis – II	3-1-0	70	30	100	40	4
02	MMAT302	Partial Differential Equations – mechanics and Gravitation - II	3-1-0	70	30	100	40	4
03	MMAT303	Fuzzy Sets and their Application - II	3-1-0	70	30	100	40	4
04	MMAT304	Operations Research – II	3-1-0	70	30	100	40	4
05	MMAT305	Fluid Dynamics – II	3-1-0	70	30	100	40	4
<b>Total (Second)</b>						<b>500</b>		<b>20</b>

**COURSE STRUCTURE:**

The syllabus with the paper combination is as under:

**SEMESTER-I**

SR. NO.	COURSE CODE	TITLE OF COURSE
01.	MMAT101	Advanced Abstract Algebra - I
02.	MMAT102	Real Analysis - I
03.	MMAT103	Topology - I
04.	MMAT104	Complex Analysis - I
05.	MMAT105	Advanced Discrete Mathematics - I

**SEMESTER -II**

SR. NO.	COURSE CODE	TITLE OF COURSE
01.	MMAT201	Advanced Abstract Algebra - II
02.	MMAT202	Real Analysis - II
03.	MMAT203	Topology - II
04.	MMAT204	Complex Analysis - II
05.	MMAT205	Advanced Discrete Mathematics - II

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## SEMESTER I

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – I SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT101</b>	
<b>TITLE</b>	<b>ADVANCED ABSTRACT ALGEBRA -1</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	The end of this course, the students will be able to: Gain skills, of solving problems using powerful concepts of group action. Gain knowledge of Normal Series, Solvable groups, Nilpotent groups. Gain ability to deal with module theory which is indispensable in wide ranges of mathematical disciplines. Gain knowledge of Nilpotent and Nil ideals. Gain knowledge of representation and rank of linear mapping.	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	Normal Series: Normal and subnormal series, Composition Series, Jordan–Hölder theorem, Solvable Group, Nilpotent Groups	15
<b>II</b>	Rings and Ideals: Maximal and Prime Ideals, Nilpotent and Nil Ideals	15
<b>III</b>	Modules: Definition and examples, Submodules, Quotient Modules, Direct Sums, Modules generated by a subset, Cyclic Module, Homomorphism of modules, Isomorphism Theorem, Exact sequence of modules, Simple modules, Semi-simple modules, Schur's lemma, Free module	15
<b>IV</b>	Field Theory: Extension fields, Algebraic and Transcendental extensions, Separable and Inseparable extensions, Normal extension, Perfect field, Finite fields, Primitive Elements, <i>algebraically closed fields.</i>	15

### TEXT BOOKS:

#### Learning Resources

#### Reference Books

1. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul – *Basic Abstract Algebra*
2. I.N. Herstein – *Topics in Algebra*, Wiley Eastern Ltd., New Delhi (1975)
3. M. Artin – *Algebra*, Prentice Hall of India (1991)
4. D.S. Malik, J.N. Mordeson, and M.K. Sen – *Fundamentals of Abstract Algebra*, McGraw Hill International Edition (1997)

#### E-Resources

- [NPTEL Online Courses](#)
- [e-PG Pathshala \(INFLIBNET\)](#)
- SWAYAM

## SEMESTER I

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – I SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT102</b>	
<b>TITLE</b>	<b>REAL ANALYSIS - I</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective (CLO)</b>	<p>The end of this course, the students will be able to:</p> <p>Gain the knowledge of Riemann-Stieltjes Integral, Sequence and Series of Functions, Power Series, Function of Several Variables.</p> <p>Gain the knowledge of Differentiability of Function in Several Variables and their relation to Partial Derivatives</p> <p>Develop competency to apply Implicit and Inverse Function Theorems and moving towards Calculus of Manifolds.</p> <p>Gain Knowledge of Riemann-Stieltjes Integral of Real Valued Function on Intervals and its extension to Complex and Vector-Valued Functions on Interval.</p>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
I	Sequence and Series of Functions: Pointwise and Uniform Convergence, Cauchy Criterion for Uniform Convergence, Weierstrass M-Test, Abel's and Dirichlet's tests for Uniform Convergence	15
II	Function of Several Variables: Linear transformation, Derivatives in an open subset of $\mathbb{R}^n$ , Contraction Principle, Inverse Function Theorem, Implicit Function, Derivatives of Higher Order, Differentiation of integrals	15
III	The Riemann-Stieltjes Integral: Definition and existence of Riemann-Stieltjes Integral Properties of the Integral, Integration and Differentiation, The Fundamental Theorem of Calculus, Integration of Vector-Valued Function	15
IV	Extremum problems with constraints: Lagrange's Multiplier Method, Differentiation of Integrals, Partitions of Unity, Differential Forms, Stokes' Theorem <i>Power Series</i>	15 1

### Learning Resources

#### Reference Books

1. Walter Rudin – *Principles of Mathematical Analysis* (3rd Edition), McGraw-Hill Kogakusha, 1976 (International Student Edition)
2. P.K. Jain and V.P. Gupta – *Lebesgue Measure and Integration*, New Age International Ltd., New Delhi, 1986 (Reprint)
3. T.M. Apostol – *Mathematical Analysis*, Narosa Publishing House, New Delhi, 1985
4. Gabriel Klambauer – *Mathematical Analysis*, Marcel Dekker, Inc., New York, 1975
5. *Real Analysis: An Introduction*, Addison-Wesley Publishing Co., Inc., 1968
6. E. Hewitt and K. Stromberg – *Real and Abstract Analysis*, Springer, Berlin, 1969

#### E-Resources

- [NPTEL Online Courses](#)
- [e-PG Pathshala \(INFLIBNET\)](#)
- [SWAYAM](#)

## SEMESTER I

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – I SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT103</b>	
<b>TITLE</b>	<b>TOPOLOGY - I</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	<p>The end of this course, the students will be able to:</p> <p>Gain knowledge of countable and uncountable sets, topological spaces, connectedness, compactness, first and second countable spaces, Projection maps, filters and their comparison. Gain skills to define topological spaces, product topology, metric topology, quotient space. Gain competency to discuss continuous functions, connected space, compact space, complete metric space, related theorem on Baire space.</p> <p>Gain competency of topological space and having grasp on basic result.</p> <p>Gain ability to express T-1, T-2, T-3 and T-4 separation axioms and use them to prove various properties.</p>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
I	Definition and Examples of Metric Space; Definition and Examples of Topology; Neighbourhood; Countable and Uncountable Sets; Cantor's Theorem; Continuum Hypothesis	15
II	Definition and Examples of Topological Spaces; Closed Sets; Closure; Dense Subsets; Base and Sub-bases; Subspaces and Relative Topology; Continuity and Homomorphism	15
III	Connectedness; Continuity and Connectedness; Components; Totally Disconnected Space	15
IV	Compactness; Continuous Functions and Compact Sets; Sequentially and Countably Compact Sets; Compactness for Metric Spaces	15

### Learning Resources

#### Reference Books

1. **Jame R. Munkres – *Topology: A First Course***
2. **K.D. Joshi – *Introduction to General Topology***
3. **J. Dugundji – *Topology***
4. **B. Mendelson – *Introduction to Topology***
5. **K.K. Jha – *Advanced General Topology***
6. **K.D. Joshi – *Introduction to General Topology*, New Age International (P) Ltd., New Delhi**

#### E-Resources

- [NPTEL Online Courses](#)
- [e-PG Pathshala \(INFLIBNET\)](#)
- [SWAYAM](#)

The image shows several handwritten signatures and initials in blue ink. On the left, there is a large, stylized signature that appears to be 'S'. In the center, there is a signature that looks like 'S. Joshi'. To the right of that, there is another signature that is partially obscured and looks like 'S. Joshi'. Further to the right, there are some initials that look like 'u h l -'. At the bottom center, there is a signature that looks like 'S. Joshi'.

## SEMESTER I

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – I SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT104</b>	
<b>TITLE</b>	<b>COMPLEX ANALYSIS</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	<p>The end of this course, the students will be able to:</p> <p>Gain knowledge of complex integration, argument principle, Rouches theorem, Residues theorem, bilinear transformation, conformal mappings, Weierstrass factorization theorem, Runge's theorem, power series, canonical products, range of analytic function, Schottky's theorem, univalent function. Gain knowledge of expressing, Residue theorem and calculation of complex and real integrals.</p> <p>Gain ability of calculating complex integrals using Residue theorem. Gain ability to express logarithmic derivative and Rouché's theorem.</p> <p>Gain ability of viewing analytic functions as conformal mappings</p>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
I	Algebra of Complex Numbers; The Complex Plane; Power Series; Analytic Functions of a Complex Variable; Limit of a Function; Continuity; Differentiability; Analytic and Regular Functions; Cauchy-Riemann Equations	15
II	Complex Integration; Cauchy–Goursat Theorem; Cauchy's Integral Formula; Higher Order Derivative; Morera's Theorem; Cauchy Inequality and Liouville's Theorem; The Fundamental Theorem of Algebra; Taylor's Theorem; Maximum Modulus Principle; Schwarz Lemma; Laurent's Series; Isolated Singularities	15
III	Residues; Cauchy's Residue Theorem; Evaluation of Integrals; Branches of Many-Valued Functions with Special References to $\arg(z)$ and $z^n$ ; Bilinear Transformations – Their Conformal Mappings, Properties and Classification; Definitions and Examples of Mappings	15
IV	Spaces of Analytic Functions; Hurwitz's Theorem; Montel's Theorem; Riemann Mapping Theorem	15

### Learning Resources

#### Reference Books

1. B.S. Tyagi – *Functions of a Complex Variable*, Kedar Nath, Ram Nath Prakashan, Meerut, 1981
2. S. Ponnusamy – *Foundations of Complex Analysis*, Narosa Publishing House, 1997
3. L. Ahlfors – *Complex Analysis*, McGraw Hill Education
4. J.B. Conway – *Functions of One Complex Variable*, Springer-Verlag International Student Edition, Narosa Publishing House, 1990
5. S. Ponnusamy – *Foundations of Complex Analysis*, Narosa Publishing House, 1997 (Duplicate reference consolidated)
6. J.N. Sharma – *Functions of a Complex Variable*

#### E-Resources

- [NPTEL Online Courses](#)
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- [SWAYAM](#)

## SEMESTER I

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – I SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT105</b>	
<b>TITLE</b>	<b>ADVANCED DISCRETE MATHEMATICS - I</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	<p>The end of this course, the students will be able to:</p> <p>Gain knowledge of Mathematical logic, semi groups and monoids, lattices, Boolean Algebra, logical circuit, graph theory, trees, planar graphs, matrices of graphs, directed graphs, formal languages, grammars and finite state machine. Gainability to define semi groups, monoids homomorphism and isomorphism.</p> <p>Gainability to interpret lattices, Boolean Algebra, Karnaugh map, switching circuits.</p> <p>Gainability to use graphs as unifying theme for various combinatorial problems.</p> <p>Gainability to illustrate tautology, tautological implications, truth tables, normal forms, principal normal forms.</p> <p>Gainability to write an argument using logical notation and determine if the arguments is or is not valid.</p>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	Boolean Algebra: Boolean Algebras; Duality; Sub-Algebra; Homomorphism and Isomorphism of Boolean Algebra; Boolean Algebras as Lattices; Boolean Function; Direct Products; Atoms and Minterms; Minterm Boolean Forms	15
<b>II</b>	Lattices: Lattices as Partially Ordered Sets and their Properties; Duality; Lattices as Algebraic Systems; Sublattices; Direct Products; Homomorphism and Isomorphism; Bounded Lattices; Complete, Complemented, Modular, and Distributive Lattices	15
<b>III</b>	Mathematical Logic: Statements; Symbolic Representation; Tautologies; Contradictions; Duality; Operations; Quantifiers; Arguments; Predicates and Validity of Propositions	15
<b>IV</b>	Semigroups and Monoids: Definition and Examples of Semigroups and Monoids; Homomorphism of Semigroups and Monoids; Congruence Relation and Quotient Semigroup; Sub-Semigroup; Sub-Monoids	15

### Learning Resources

#### Reference Books

1. J.P. Tremblay & R. Manohar – *Discrete Mathematical Structures with Applications to Computer Science*, McGraw Hill Book Co., 1997
2. Seymour Lipschutz – *Finite Mathematics* (International Edition, 1993), McGraw Hill Book Co., New York
3. N. Deo – *Graph Theory with Applications to Engineering and Computer Science*, Prentice Hall of India
4. S. Wiitala – *Discrete Mathematics: A Unified Approach*, McGraw Hill Book Co., New York
5. C.L. Liu – *Elements of Discrete Mathematics*, McGraw Hill Book Co.
6. M.K. Gupta – *Discrete Mathematics*, Krishna Prakashan Media

(Duplicate entries removed and arranged for clarity)

#### E-Resources

- [NPTEL Online Courses](#)
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## SEMESTER -II

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – II SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT201</b>	
<b>TITLE</b>	<b>ADVANCED ABSTRACT ALGEBRA – II</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	Gain knowledge of <b>Field Theory</b> . Gain knowledge of <b>Galois Theory</b> . Test if a polynomial is <b>irreducible in finite fields (Galois fields)</b> . Understand <b>Smith Normal Form and Principal Ideal Domains (PID)</b> in detail. Understand <b>Finitely Generated Modules over PID</b> .	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	Linear Transformation: Algebra of Linear Transformation; Characteristic Roots; Matrices and Linear Transformation	15
<b>II</b>	Canonical Forms: Similarity of Linear Transformations; Invariant Subspaces; Reduction to Triangular Forms	15
<b>III</b>	Nilpotent Transformations: Index of Nilpotency; Invariants of a Nilpotent Transformation; The Primary Decomposition Theorem; Jordan Blocks and Jordan Forms	15
<b>IV</b>	Smith Normal Form over a Principal Ideal Domain and Rank; Fundamental Structure Theorem for Finitely Generated Abelian Groups; Rational Canonical Form	15

### Learning Resources

#### Reference Books

1. P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul – *Basic Abstract Algebra* (2nd Edition), Cambridge University Press, Indian Edition, 1997
2. Luther & I.B.S. Passi – *Algebra Vol. I, II & III*, Narosa Publishing House, New Delhi
3. I.N. Herstein – *Topics in Algebra*, Wiley Eastern, New Delhi
4. S. Lang – *Algebra* (3rd Edition), Addison-Wesley, 1993
5. N. Jacobson – *Basic Algebra Vols. I & II*, Hindustan Publishing Company, 1980

#### E-Resources

- [NPTEL Online Courses](#)
- [e-PG Pathshala \(INFLIBNET\)](#)
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## SEMESTER -II

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – II SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT202</b>	
<b>TITLE</b>	<b>REAL ANALYSIS - II</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	By the end of this course, students will be able to: <ol style="list-style-type: none"> <li>1. <b>Understand</b> the concepts of Measurable Sets, Measurable Functions, Lebesgue Integrals, Differentiation, and Integration in the context of Lebesgue Spaces.</li> <li>2. <b>Develop skills</b> to establish the Measurability or Non-Measurability of Sets and Functions.</li> <li>3. <b>Apply</b> the conditions under which the Fundamental Theorem of Calculus is valid within the framework of Lebesgue Integration.</li> <li>4. <b>Interpret</b> Differentiation and Integration as inverse operations in the broader context of Lebesgue Theory.</li> </ol>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	Power Series; Uniqueness Theorem for Power Series; Abel's Theorem and Taylor's Theorem; Tauber's Theorem; Lebesgue Outer Measure; Regularity; Measurable Set; Measurable Functions	15
<b>II</b>	Borel and Lebesgue Measurability; Non-negative Functions; The General Integral; Integration of Series; Measure and Outer Measures; Extension of Measure	15
<b>III</b>	Uniqueness of Extension; Completion of a Measure; Measure Spaces; Integration with Respect to a Measure; Riemann and Lebesgue Integrals; The Four Derivatives; Lebesgue Differentiation Theorem; Differentiation and Integration; Functions of Bounded Variation; $L^p$ -Spaces	15
<b>IV</b>	Convex Functions; Jensen's Inequality; Hölder and Minkowski Inequalities; Completeness of $L^p$ -Spaces; Convergence in Measure	15

### Learning Resource

#### Reference Books:

1. *Lebesgue Measure and Integration* – P. K. Jain and V. P. Gupta, New Age International (P) Limited Publication, New Delhi, 1986 (Reprint 2000).
2. *Real Analysis* – H. L. Royden, Macmillan Publishing Co. Inc., Fourth Edition, New York, 1962.
3. *Methods of Real Analysis* – R. R. Goldberg.
4. *Principles of Mathematical Analysis* – W. Rudin.
5. *The Elements of Real Analysis* (2nd Edition) – R. G. Bartle, J. Wiley & Sons, New York, London.

#### E-Resources:

- [NPTEL Online Courses](#)
- [e-PG Pathshala](#)

## SEMESTER -II

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – II SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT203</b>	
<b>TITLE</b>	<b>TOPOLOGY - II</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	By the end of this course, the students will be able to: <ol style="list-style-type: none"> <li>1. Gain the ability to express regularity and normality separation axioms and use them to prove various properties.</li> <li>2. Gain skills to construct the product topology on product spaces.</li> <li>3. Prove basic results about completeness, connectedness, and convergence within these structures.</li> <li>4. Learn about nets and convergence, filters, and ultrafilters.</li> </ol>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	First and second countable spaces, Lindelöf theorem, Separable spaces, Second Countability and Separability	15
<b>II</b>	Separation axioms: $T_0, T_1, T_2, T_3, T_4$ – their characterization and basic properties, Urysohn's Lemma, Tietze Extension Theorem	15
<b>III</b>	Projection Maps, Product invariant properties, Finite products, Tychonoff products, Tychonoff Theorem, Alexander Sub-base Lemma, Embedding and Metrization Theorem, Urysohn's Embedding Theorem	15
<b>IV</b>	Filters and their comparison, Ultrafilters, Filter bases, Convergence of filters, Characterization of continuity by filters, Convergence of nets, Hausdorffness and nets	15

### Learning Resources

#### Reference Books:

1. G.F. Simmons – *Introduction to Topology and Modern Analysis*, McGraw-Hill.
2. M.J. Mansfield – *Introduction to Topology*, Van Nostrand, Princeton, New Jersey, 1963.
3. James R. Munkres – *Topology: A First Course*, Prentice Hall, 1974.
4. J. Dugundji – *Topology*, Boston: Allyn and Bacon, 1966.
5. B. Mendelson – *Introduction to Topology*, Dover Publications, 1990.
6. K.D. Joshi – *Introduction to General Topology*.
7. J.N. Sharma – *Topology*.
8. K.K. Jha – *Advanced General Topology*.

#### E-Resources:

- [NPTEL Online Courses](#)
- [INFLIBNET e-PG Pathshala](#)
- [SWAYAM Portal](#)

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## SEMESTER -II

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – II SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT204</b>	
<b>TITLE</b>	<b>COMPLEX ANALYSIS - II</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	<p>By the end of this course, students will be able to:</p> <ol style="list-style-type: none"> <li>1. Represent functions as Taylor, Power, and Laurent series, classify singularities and poles, find residues, and evaluate complex integrals using the residue theorem.</li> <li>2. Apply problem-solving techniques using complex analysis in diverse contexts such as Physics, Engineering, and Mathematics.</li> <li>3. Express entire functions in the form of canonical products, understand the theory related to the convergence of infinite products, and express some well-known functions as infinite products.</li> </ol>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	Power series method of analytic continuation, Schwartz Reflection Principle, Monodromy theorem and its consequences, Harmonic function on a disc, Harnack's inequality and theorem.	15
<b>II</b>	Weierstrass factorization theorem, Gamma function and its properties, Riemann Zeta function, Riemann's functional equation, Runge's theorem, Mittag-Leffler's theorem.	15
<b>III</b>	The range of an analytic function, Bloch's theorem, The Little Picard theorem, Schottky's theorem, Univalent functions, Bieberbach's conjecture and the "1/4-theorem".	15
<b>IV</b>	Entire functions: Order of an entire function, Exponent of convergence, Borel's theorem, Hadamard's factorization theorem, The Gamma function.	15

### Learning Resources

#### Reference Books:

1. B. S. Tyagi: *Functions of a Complex Variable*, Kedar Nath, Ram Nath Prakashan, Meerut, 1981.
2. S. Ponnusamy: *Foundation of Complex Analysis*, Narosa Publishing House, 1997.
3. L. Ahlfors: *Complex Analysis*, McGraw Hill Education.
4. J. B. Conway: *Functions of One Complex Variable*, Springer-Verlag International Student Edition, Narosa Publishing House, 1980.
5. D. Sarason: *Complex Function Theory*, Hindustan Book Agency, Delhi, 1994.

#### E-Resources:

- [NPTEL Online Courses](#)
- [INFLIBNET e-PG Pathshala](#)
- [SWAYAM](#)

## SEMESTER -II

<b>PROGRAMME</b>	<b>M.SC. MATHEMATICS – II SEMESTER</b>	
<b>CORE COURSE</b>	<b>COURSE CODE: MMAT205</b>	
<b>TITLE</b>	<b>ADVANCED DISCRETE MATHEMATICS – II</b>	
<b>Course Credits</b>	<b>04 Credits</b>	
<b>Total Marks</b>	<b>Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40</b>	
<b>Course Learning Objective</b>	By the end of this course, the students will be able to: <ul style="list-style-type: none"> <li>• Demonstrate traversal methods for trees and graphs.</li> <li>• Assimilate various graph theoretic concepts and familiarize with their applications.</li> <li>• Gain knowledge of languages and grammars, finite state machines and their transitions, machine minimization, and describe homomorphism automata and their equivalence to deterministic finite automata.</li> <li>• Understand counting methods, probability, and probability inequalities.</li> </ul>	
<b>Unit</b>	<b>Description</b>	<b>No. of Lectures / Hours</b>
<b>I</b>	Formal Languages, Grammar and Finite State Machines; Grammars; Finite State Machines and their Transition Table Diagrams; Equivalence of Finite State Machines; Machine Minimization / Reduced Machines; Homomorphism in Finite Automata and their equivalence with Deterministic Finite Automata; Turing Machines and Partial Recursive Functions	15
<b>II</b>	Logical Circuits: Application of Boolean Algebra, Switching Theory (Using AND, OR, NOT gates), Finite state Machines and their Transition, Table diagrams, Equivalence of Finite state Machines, reduced machines, Homomorphism Finite automata, and equivalence of its power to that of Deterministic finite automata, Moore and Mealy Machines, Turing machines, and partial recursive functions.	15
<b>III</b>	Graph Theory: Graphs, Subgraphs and Complements; Walks, Paths, Circuits; Connected Graphs and Components; Operations on Graphs; Types of Graphs; Eulerian Graphs, Fleury's Algorithm, Hamiltonian Graphs; Weighted Undirected Graphs; Dijkstra's Algorithm; Strong Connectivity and Warshall's Algorithm	15
<b>IV</b>	Planar Graphs; Matrices of Graphs; Directed Graphs; Trees, Spanning Trees, Directed Trees, Search Trees, Tree Traversals; Fundamental Circuits; Planar Graphs; Euler's Formula for Connected Planar Graphs	15

### Part C: Learning Resource

#### Reference Books

1. J.P. Tremblay & R. Manohar: *Discrete Mathematical Structure with Applications to Computer Science*. McGraw Hill Book Co., 1997.
2. Seymour Lipschutz: *Finite Mathematics* (International Edition, 1993). McGraw Hill Book Co., New York.
3. N. Deo: *Graph Theory with Applications to Engineering and Computer Science*. Prentice Hall of India.
4. S. Wiitala: *Discrete Mathematics – A Unified Approach*. McGraw Hill Book Co., New York.
5. C. L. Liu: *Elements of Discrete Mathematics*. McGraw Hill Book Co.

#### E-Resources

- [NPTEL Online Courses](#)
- [e-PG Pathshala \(INFLIBNET\)](#)
- [SWAYAM](#)


